INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**:**	**SATELLITE COMMUNICATIONS**			
Course Code	**:**	**A80452**			
Academic Year	**:**	**2018 – 2019**			
Branch	**:**	**IV - B. Tech ECE-II Sem**			
Course Structure	**:**	**Lectures**	**Tutorials**	**Practical**	**Credits**
		4	**-**	**--**	**4**
Course Faculty	**:**	**Mrs. G.Bhavana, Assistant Professor ,ECE** **Ms.U Dhanalakshmi, Assistant Professor,ECE**			

I. COURSEOVERVIEW

This course introduces the fundamentals of satellite communications that are important to communication system large bandwidth, satellite is a essential form of telecommunication and it has a large height to see large portion of area. Due to interference. It says about line-of-sight propagation paths and made possible transmission of microwaves with their consideration, communication satellites must maintain a certain separation and thus only a limited number of satellites can be placed in geo-stationary orbit to provide communication for a region. In addition only certain radio frequency bands and later on efficiency of the satellite communication systems are being increased by using higher band of frequency by increasing spectrum efficiency, developing high gain multiple spot beam antennas and frequency reusing technique.

II. PREREQUISITE(S)

Level	Credit	Periods/Week	Prerequi
UG	4	4	Analog communications, digital communications and Antennas and wave propagation

III. MARKS DISTRIBUTION

Sessional Marks (25 Marks)	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each midterm exam shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 2 ½ units of syllabus and second midterm examination shall be conducted for the remaining 2 ½ units. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).	75	100

IV. EVALUATION SCHEME

S.No	Component	Duration(Hrs)	Marks
1	I Mid Examination	1 hr 20 min	20
2	I Assignment	--	05
3	II Mid Examination	1 hr 20 min	20
4	Ii Assignment	--	05
5	End Semester Examination	3 hrs	75

V. COURSE OBJECTIVES

At the end of the course, the students will be able to:

I. Analyze the basic concept of satellite systems, its applications and its placement in the orbit.
II. Know the satellite communication subsystems such as telemetry tracking and command systems and also designing of satellite links.
III. Understand the effect of environment on satellite communication and the various techniques used for communication for transmission and reception of information.
IV. Explore the satellite navigation and global positioning systems and use of various earth station technologies.
V. Distinguish various packet communication technologies used for message transmission and reception.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the basic concept of satellite communication systems and its applications.
2. Identify effects of orbital inclination, azimuth and elevation and placement of a satellite in a Geo-stationary orbit.
3. Develop the satellite subsystems and also design various satellite links for specified frequency ranges.
4. Analyze the environmental effect on satellite communication such as Atmospheric Absorption, Cloud Attenuation, tropospheric and ionospeheric Scintillation and Low angle fading.
5. Distinguish various types of multiple access techniques used for communicating with satellites.
6. Understand the concepts of transmitters, receivers, antennas, tracking systems, and terrestrial interface.
7. Demonstrate the impacts of GPS, Navigation, NGSO constellation design for tracking and launching.
8. Explain various message transmission techniques by using satellite packet communications.

VII.HOW COURSE OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of	**H**	Assignments and Exercises
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and	**H**	Exercises, Assignments
PO3	**Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	**S**	Interactive discussions
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	**H**	Exercises and assignments
PO5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an	**S**	Work shops
PO6	**The Engineer And Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional	**N**	-
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	**N**	-
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	**N**	-
PO9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	**S**	Team participation in projects
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive	**H**	Exams and seminars
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	**H**	Exercises and assignments
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	**S**	Mini projects or projects

N=None **S=Supportive** **H = Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas like Electronics, Communications, signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	H	Lectures and Assignments
PSO2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials
PSO3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	S	Seminars and Projects

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS

UNIT - I : COMMUNICATION SATELLITE

ORBIT AND DESCRIPTION: A Brief history of satellite communication, Satellite frequency Bands, Satellite Systems, Applications, Orbital period and velocity, effects of Orbital Inclination, Azimuth and Elevation, Coverage angle and Slant Range, Eclipse, Orbital Perturbations, Placement of a Satellite in a Geo-Stationary orbit.

UNIT – II: SATELLITE SUB-SYSTEMS

Attitude and Orbit Control system, TT &C subsystem, Attitude Control , Power systems, Communication subsystems, Satellite Antenna Equipment.

SATELLITE LINK: Basic transmission Theory, System Noise Temperature and G/T ratio, Basic Link Analysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use), Link Budget.

UNIT – III: PROPAGATION EFFECTS

Introduction, Atmospheric Absorption, Cloud Attenuation, tropospheric and ionospeheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference.

MULTIPLE ACCESS: Frequency Division Multiple Access (FDMA) – Inter-modulation Calculation of C/N, Time Division Multiple Access (TDMA) – Frame Structure, Burst Structure, Satellite Switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) — Types of Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.

UNIT-IV: EARTH STATION TECHNOLOGY

Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Power Test Methods, Lower Orbit Considerations. **SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEMS**: Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers, GPS C/A Code Accuracy, Differential GPS.

UNIT-V: SATELLITE PACKET COMMUNICATIONS

Message Transmission by FDMA: MI G/i Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation, Tree Algorithm.

Text books

1. Timothy Pratt, Jeremy Allnutt, Charles Bostian "Satellite Communications", 2nd Edition, 2003, John Wiley & Sons.(T1)
2. Wilbur, L. Pritchand, Robert A. Nelson and Heuri G. Suyderhoud, "Satellite Communications Engineering" 2nd Edition., Pearson Publications. (T2)
3. TrjHa "Digital Satellite Communjcatjons", 2nd Edition, 1990, Mc.Graw Hill. (T3)

Reference books

1. Dennjs Roddy "Satellite Communications", 2nd Edition, 1996, McGraw Hill.(R1)
2. M. Richcharia "Satellite Communications: Design Principles", 2nd Ed., BSP, 2003. (R2)
3. Tn. T. Ha, "Digital Satellite Communications" 2nd Ed., MGH, 1990. (R3)
4. K. N. Raja Rao "Fundamentals of Satellite Communications", PHI, 2004. (R4)

X. COURSEPLAN

At the end of the course, the students are able to achieve the following course learning outcomes:

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	Describe the basic idea and importance of satellite communication	A Brief history of satellite Communication	T1:**1**.1
2-3	List out the frequency bands of satellite communication	Satellite Frequency Bands, Satellite Systems	T1:1.2
4	List out the various applications of satellite communication	Applications, Orbital Period and Velocity	T1:1.3
5-6	Compare various effects of satellite systems	Effects of orbital inclination, Azimuth and Elevation	T1:1.4
7-8	Define the coverage angle and slant height	Coverage angle and slant Range.	T1:1.5
9-12	Formulate the orbital perturbations and placing geostationary orbit	Eclipse, Orbital Perturbations Placement of a Satellite in a Geo-Stationary orbit	T1:1.6
13-16	Evaluate the control system	Attitude and Orbit Control system,TT &C subsystem	T1:2.1
17	Define the attitude of control subsystem	Attitude Control subsystem	T1:2.2
18-19	Describe measurement of power system	Power systems, Communication subsystems	T1:2.3
20	Design of satellite antenna	Satellite Antenna Equipment	T1:2.3
21-22	Analyze transmission theory, System Noise Temperature and G/T ratio.	Basic Transmission Theory, System Noise Temperature and G/T ratio	T1:2.4
23-26	Differentiate Basic Link Analysis, Interference Analysis	Basic Link Analysis, Interference Analysis	T1:2.6
27-29	Design satellite Links for a specified C/N	Design of satellite Links for a specified C/N, (With and without frequency Re-use)	T1:2.7
30-32	Identify Link Budget	Link Budget	T1:2.8

39-40	Explain tropospheric and ionospeheric Scintillation and Low angle fading	Tropospheric and ionospeheric Scintillation and Low angle fading	T1:3.1
41-42	Formulate & Relate Rain induced attenuation, rain induced cross polarization	Rain induced attenuation, rain induced cross polarization interference	T1:3.2
43	Evaluate Inter-modulation Calculation of C/N	Frequency division Multiple Access (FDMA) Inter-modulation Calculation of C/N	T1:3.3
44-45	Employ Frame Structure of TDMA	Time Division Multiple Access (TDMA) – Frame Structure	T1:3.3
46-48	Explain Burst Structure, Satellite Switched TDMA	Burst Structure, Satellite Switched TDMA	T1:3.5
49-50	Define On-board Processing	On-board Processing	T1:3.6
51	Explain Demand Assignment Multiple Access	Demand Assignment Multiple Access (DAMA) — Types of Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception	T1:3.6
52	Explain Transmitters, Receivers, Antennas, Tracking Systems	Transmitters, Receivers, Antennas, Tracking Systems	T1:4.1
53	Discuss Terrestrial Interface, Power Test Methods	Terrestrial Interface, Power Test Methods, Lower Orbit Considerations	T1:4.2
54-55	List Radio and Satellite Navigation, GPS Position Location Principles	Radio and Satellite Navigation, GPS Position Location Principles	T1:4.4
56	Explain GPS Receivers, GPS C/A Code Accuracy, Differential GPS	GPS Receivers, GPS C/A Code Accuracy, Differential GPS	T1:4.6
57	Explain Message Transmission by FDMA: MI G/i Queue	Message Transmission by FDMA: MI G/i Queue	T1:5.1-5.3
58	Define Message Transmission by TDMA	Message Transmission by TDMA	T1:5.4
59	Explain ALOHA-Satellite	PURE ALOHA-Satellite Packet Switching, Slotted Aloha	T1:5.9
60	Explain Tree Algorithm	Packet Reservation, Tree Algorithm	T1:5.7

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I.	H			S			S			H		S	S		H
II.		H	S							S		S	S		
III.			S	S	S		H							H	S
IV.	S	H	S							S		S		S	
V.	S				S							S	H	S	

S=Supportive **H = Highly Related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	H			S						S			S		H
2.			H									S	S	H	
3.			H	S	S					S					S
4.	S			S	S		H			S		S	H	S	
5.			H												
6.	S			S	H					S		S	S		H
7.					S								H		S
8.	S			S						H		S		H	

S=Supportive H = Highly Related

Prepared By:

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